Pre- and postnatal influences on preschool mental health: a large-scale cohort study

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Background: Methodological challenges such as confounding have made the study of the early determinants of mental health morbidity problematic. This study aims to address these challenges in investigating antenatal, perinatal and postnatal risk factors for the development of mental health problems in pre-school children in a cohort of Western Australian children. Methods: The Raine Study is a prospective cohort study of 2,868 live born children involving 2,979 pregnant women recruited at 18 weeks gestation. Children were followed up at age two and five years. The Child Behaviour Checklist (CBCL) was used to measure child mental health with clinical cut-points, including internalising (withdrawn/depressed) and externalising (aggressive/destructive) behaviours (n = 1707).

Results: Multinomial logistic regression analysis showed that the significant risk factors for behaviour problems at age two were the maternal experience of multiple stress events in pregnancy (OR = 1.20, 95% CI = 1.06, 1.37), smoking during pregnancy (OR = 1.30, 95% CI = 1.06, 1.59) and maternal ethnicity (OR = 3.34, 95% CI = 1.61, 6.96). At age five the experience of multiple stress events (OR = 1.17, 95% CI = 1.08, 1.27), cigarette smoking (OR = 1.19, 95% CI = 1.03, 1.37), male gender (OR = 1.43, 95% CI = 1.02, 2.00), breastfeeding for a shorter time (OR = 0.97, 95% CI = .94, .99) and multiple baby blues symptoms (OR = 1.08, 95% CI = 1.02, 1.14) were significant predictors of mental health problems. Conclusions: Early childhood mental health is significantly affected by prenatal events in addition to the child’s later environment. Interventions targeting adverse prenatal, perinatal and postnatal influences can be expected to improve mental health outcomes for children in the early years. Keywords: Mental health, pre-school children, behavioural development, Raine Study, CBCL.

The World Health Organization (WHO) estimates a worldwide prevalence of mental health morbidity in children and adolescents of approximately 20% and identifies mental health in the early years as a key target for intervention strategies (World Health Organization, 2001). It is well established that mental health in early childhood has a significant influence on subsequent mental health outcomes (Preski & Walker, 1997). Poor mental health in early childhood also has a negative impact on the child’s physical health and school achievements (Sawyer et al., 2001). Therefore the early risk factors associated with mental health morbidity in pre-school children is a vital area of empirical enquiry both in its own right and as a prerequisite for the development of effective preventive interventions to improve mental health in children and adults.

There is growing evidence that prenatal experiences can influence later psychological outcomes (Pennington, 2002). The pregnancy and postpartum periods have been recognised in relation to risk factors on the causal pathways for serious mental illnesses such as schizophrenia; however, these findings are complicated by methodological difficulties (Geddes & Lawrie, 1995; Kessler, 2000; Susser, Brown, & Matte, 1999). Geddes and Lawrie (1995) found in their meta-analysis that obstetric complications are potentially responsible for a two-fold increase in the later development of early-onset schizophrenia, although the authors do note possible sampling bias in existing research. Susser and colleagues (1999) also reviewed the literature linking prenatal insults with the later development of schizophrenia and noted that the study of the early determinants of mental health is potentially riddled with methodological challenges, such as confounding bias and crude measures of exposures.

There has been a lesser focus on the early determinants of adverse behavioural outcomes in children and young adults, and such research is not immune from these same methodological conundrums. Limited associations were found in a previous prospective pregnancy study that examined a variety of pre- and perinatal risk factors and child behaviour at age five (O’Callaghan, Williams, Andersen, Bor, & Najman, 1997). The authors observed that only male gender, more antenatal admissions and cigarette smoking during pregnancy

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were significant predictors of either externalising or internalising behaviour in the adjusted analysis; however, the use of a modified measure of child behaviour may have influenced the absence of further significant associations. Another study reviewed pre- and perinatal risk factors for child behavioural problems, specifically attention deficit hyperactivity disorder (ADHD); however, the authors of this study predominantly looked at the effects of prenatal maternal substance use and stress and did not include other types of child behavioural problems (Linnet et al., 2003). Some relevant research has used retrospective data collection. Allen, Lewinsohn, and Seeley (1998) conducted a comprehensive analysis and presented some striking findings as to the role of adverse pre- and perinatal events, such as prenatal stress and premature birth, and the development of psychopathology in adolescence. However, the analysis is based on the maternal retrospective recall of events that occurred between 14 and 18 years previously and hence the reliability of the results is called into question (Allen et al., 1998).

Putting such methodological issues aside, it is clear from the existing research that there are specific negative behavioural sequelae associated with specific pre- and perinatal events such as maternal characteristics (Fergusson & Woodward, 1999), socioeconomic hardship (Duncan, Brooks-Gunn, & Klebanov, 1994), stress experience (Rice, Jones, & Thapar, 2007), obstetric complications (O’Callaghan et al., 1997), and cigarette smoking (Martin, Dombrowski, Mullis, Wisenbaker, & Huttunen, 2006). It is also clear that risk factors for child behaviour problems, such as those listed above, do not exist within a vacuum but rather exert their influence from within a complex network of biological, socioeconomic and psychological influences.

Given the importance of these methodological considerations, it is essential to unpack the relationships between antenatal, perinatal and postnatal risk and later mental health outcomes through complex analysis of a longitudinal nature (Angold & Egger, 2007; Kessler, 2000). What is currently lacking is a comprehensive analysis that takes into account the multiple risk factors for behavioural problems in early childhood and analyses these multiple factors together within a prospective pregnancy cohort to gain a better understanding of which factors are of particular importance in terms of the development of psychopathology.

In this study we aim to prospectively examine a comprehensive range of antenatal, perinatal and postnatal risk factors and their impact on problem behaviours in early childhood using complete behavioural data from the Western Australian Pregnancy Cohort (Raine) Study. This analysis is an improvement on previous research outlined above by using prospectively collected data from a large population-based sample, analysing a multitude of factors together to minimise confounding bias, and using a valid and reliable measure of child behaviour, the Child Behaviour Checklist (Achenbach, 1991). Understanding the influence of early determinants can inform the appropriate targeting of resources, especially during pregnancy, and the development of effective clinical interventions to assist in lessening the social, emotional and economic burden of child mental health problems.

**Method**

**Study population**

The study is based on data from the Western Australian Pregnancy Cohort Study, commonly known as the Raine Study. The Raine Study is a longitudinal study following women who were recruited at or around 18 weeks gestation ($n = 2979$) through the public antenatal clinic at King Edward Memorial Hospital (KEMH) and nearby private clinics in Perth, Western Australia, from May 1989 through to November 1991. The enrolment methods are reported elsewhere (Newham, Evans, Michael, Stanley, & Landau, 1993). Briefly, to be eligible for enrolment, the women were required to have a gestation of between 16 and 20 weeks, sufficient English language skills, an expectation to deliver at KEMH, and an intention to reside in Western Australia to allow for future follow-up of their child. At birth, a total of 2,868 live born children (96%) were available for follow-up. All follow-ups of the study families were approved by the Human Ethics Committee at KEMH and/or Princess Margaret Hospital for Children in Perth.

**Measures – Child Behaviour Checklist (CBCL)**

Child mental health was measured at age two by the Child Behaviour Checklist for Ages 2–3 (CBCL/2–3). The CBCL/2–3 is a 99-item, empirically validated measure of child behaviour by parent report (Achenbach, 1987). At age five the children were assessed using the CBCL for Ages 4–18 (CBCL/4–18). The CBCL/4–18 is a 118-item commonly used dimensional measure of child behaviour during the previous six months and shows good internal reliability and validity in a number of population settings (Achenbach, 1991; Achenbach & McConaughy, 1997). A clinical calibration with Australian children demonstrated moderately high sensitivity (83% overall) and specificity (87% overall) to a clinical diagnosis, and good test–retest reliability (Zubrick et al., 1997). The three year predictive validity of the CBCL/2–3 for CBCL/4–18 outcomes across both sexes is $r = .49$, indicating good predictive power (Achenbach et al., 1987).

Both the CBCL/2–3 and CBCL/4–18 produce a T-score for total behaviour, in addition to apportioning factors into clinical domains and internalising and externalising behaviour sub-scales (Achenbach, 1991). The withdrawal, somatic and anxious/depressed domains are grouped together to determine a total score for *internalising* behaviours, which are associated with depression, anxiety, and withdrawal (Achenbach & McConaughy, 1997). The domains of delinquency and
aggression are grouped to determine a score for externalising behaviours, which are implicated in the psychopathology of mental health disorders such as attention deficit hyperactivity disorder (ADHD) and conduct disorder (Achenbach & McConaughy, 1997).

As recommended by the CBCL manual, we applied clinical cut-off scores to the total CBCL T-scores to obtain a binary variable indicative of overall mental health morbidity, and internalising and externalising morbidity (Achenbach, 1991; Drotar, Stein, & Perrin, 1995). We chose to use clinical cut-point variables rather than continuous scores as we were examining the development of mental health problems and therefore required a clinical point of definition for morbidity.

In this study, a T-score of greater than 60 indicated mental health morbidity, consistent with CBCL norms (Achenbach & McConaughy, 1997). A variable with four levels was created to indicate the presence of mental health morbidity at age two only, age five only, and both age two and age five as an indicator of ongoing problems in comparison with the non-clinical sample.

Explanatory variables

Antenatal determinants. A number of sociodemographic influences in the antenatal period were examined, including maternal age at conception, maternal education, maternal ethnicity and maternal psychiatric history. Maternal education at the time of birth was included as a continuous variable representing the highest completed year of secondary education. Maternal ethnicity was originally recorded in the dataset as Caucasian, Aboriginal, or other (9%), which predominately consisted of Asian mothers. Aboriginal mothers (2.2% of cohort) were excluded from the analysis due to missing CBCL data. Maternal psychiatric history (2.4% of the cohort) was also not included in the model for the same reason.

We examined maternal smoking during pregnancy with a continuous variable representing increasing cigarettes smoked per day, measured at approximately 18 weeks gestation. Preliminary analysis showed that the number of cigarettes smoked per day by 34 weeks gestation was strongly correlated with the number of cigarettes smoked at 18 weeks gestation ($r = .866, p < .001$). We therefore used the amount of cigarettes smoked at 18 weeks gestation to represent smoking frequency during pregnancy. Data on alcohol consumption during pregnancy was also collected at 18 and 34 weeks gestation.

Total family income during pregnancy and the presence of the child’s biological father in the family home during pregnancy (yes or no) were also considered. Family income was dichotomised according to minimum household income levels, or the ‘poverty line’ (less than $24,000 per annum compared with $24,000 per annum or greater), defined by the Australian government and utilised in similar population studies (Sawyer et al., 2001).

Mothers were asked at 18 weeks and 34 weeks gestation whether or not they had experienced any of 10 major life stress events selected from the 67-item life stress inventory developed by Tennant and Andrews (1976). These were: pregnancy problems, death of a close friend or relative, separation or divorce, marital problems, problems with children, job loss (involuntary), partner’s job loss (involuntary), money problems, residential move or other stressful event. The question on the 18 weeks gestation questionnaire asked whether any of the events had been experienced since becoming pregnant and, on the 34 weeks gestation questionnaire, whether any of the events had been experienced within the last four months, ensuring that the same event was not counted twice. We examined the number of stress events experienced at 18 weeks and 34 weeks gestation and given their near identical impact on mental health morbidity we created a variable representing the cumulative number of stressful events experienced since becoming pregnant.

Perinatal determinants. We examined gestational age at birth in weeks as a continuous variable. The gender of the child (male or female) was also included in our model, in addition to how many siblings the child had at the time of birth (continuous). Apgar scores five minutes after birth were collected.

Postnatal determinants. Breastfeeding was examined as a continuous variable representing the total duration of breastfeeding in months after collating information from the feeding questionnaire at ages one, two and three. Postpartum mood disturbance was measured using an index of 16 postnatal feelings on the Blues Questionnaire, completed by mothers after birth and while still in hospital. These 16 items were a summation of the 22 items on the Blues Scale developed by Kennerley and Gath (1989), a robust and valid measure of ‘baby blues’ symptoms immediately post-partum (Henshaw, 2003). The number of blues feelings was included as a continuous variable because previous research has shown that women experiencing higher levels of ‘baby blues’ symptoms in the first days after birth are more likely to develop postnatal depression later (Henshaw, Foreman, & Cox, 2004).

Procedure

Informed consent to participate in the study was obtained from the mother of each child at every follow-up. Data regarding social, economic, and demographic characteristics and the experience of life stress events were collected at enrolment (18 weeks gestation) and at 34 weeks gestation. Perinatal data were collected at birth, ‘baby blues’ symptoms in hospital shortly after birth, and infant feeding information was collected at one, two and three years of age. The study children and their families were followed-up at two and five years of age by questionnaire, which included sociodemographic and behavioural information.

The aim of the follow-ups was to collect data as close as possible to the intended age, although the range of ages being examined increased as the study continued. All cohort studies have problems from loss to follow-up although the attrition rate in our study was likely to be non-random. At age two, 69% children participated in the follow-up ($M_{age} = 26$ months, $SD = 1.9$) while 76% participated at age five ($M_{age} = 71$ months, $SD = 2.6$). Teenage and young mothers, those who did not live with the child’s biological father at birth, those who experienced high levels of stress and those whose child had a
lower gestational age were less likely to remain in the study at two and five years, potentially having an effect on our observed results (Li et al., 2008). However, given that the initial cohort over-represented socially-disadvantaged women, this loss to follow-up reduces the bias and may have increased the generalisability of the study.

**Statistical analysis**

Correlations between risk factors were calculated [see addendum] and frequency data analysed (Table 1). Univariate multinomial logistic regression analysis was initially performed to determine the relationships between explanatory variables and total mental health morbidity (Table 2), and internalising and externalising problems (not presented). The four-tiered nominal outcome was ‘no mental health morbidity’ and morbidity at age two only, age five only, and at both ages (all odds ratios have the children with ‘no mental health morbidity’ as the denominator). The preliminary univariate analysis showed no relationship between alcohol consumption in pregnancy or Apgar scores measured five minutes after birth and the CBCL outcomes, therefore these variables were not included. All explanatory variables were then block entered into a multivariable multinomial logistic regression model for total behavioural morbidity (Table 3) and internalising and externalising morbidity (Table 4). We tested for two-way interaction effects between the variables that were shown to be the most significant in the multinomial logistic regression analysis; however, there were no more significant results than would be expected by chance and therefore these interactions were not included in the final model. We used SPSS Version 15.0 in our data analysis (SPSS Inc., 2006).

**Results**

**Prevalence**

The frequency distributions of the outcome and explanatory variables are presented in Table 1 by continuous and categorical status. Eleven and a half percent of two-year-old children had CBCL T-scores above the clinical cut-point for total behavioural morbidity, while 20% of five-year-old children had CBCL T-scores above the clinical cut-point. Over 6% had a clinically significant T-score (≥60) at both ages, so 5% of two-year-olds and 14% of five-year-olds had one episode of morbidity (Table 1). Externalising problems were relatively more common than internalising problems at age two and at both ages, while internalising problems were more common at age five. The mean maternal age at conception was 28 years (SD = 5.65), and 38% of mothers had left secondary education by the completion of year 10. Almost 9% of mothers were of other ethnicity than Caucasian or Aboriginal, and 23% smoked at least one cigarette per day during pregnancy. In our cohort 27% of mothers had a total family income below the poverty line, 10% of mothers did not live with the biological father of their child, and the mean number of stress events experienced in pregnancy was two (SD = 1.97). The mean gestational age in weeks was 39 (SD = 2.08), and 38% of mothers had left secondary education by the completion of year 10. Almost 9% of mothers were of other ethnicity than Caucasian or Aboriginal, and 23% smoked at least one cigarette per day during pregnancy. In our cohort 27% of mothers had a total family income

<table>
<thead>
<tr>
<th>Table 1 Frequency characteristics for the cohort</th>
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<tbody>
<tr>
<td>Continuous variables</td>
</tr>
<tr>
<td>Maternal Age at Conception* years</td>
</tr>
<tr>
<td>Stress Events in Pregnancy* number of events</td>
</tr>
<tr>
<td>Gestational Age* weeks</td>
</tr>
<tr>
<td>Breastfeeding Duration* months</td>
</tr>
<tr>
<td>Baby blues* number of blues symptoms</td>
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<tr>
<td>Maternal Education* highest school year</td>
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<tr>
<td>Categorical variables</td>
</tr>
<tr>
<td>CBCL Year 2 Morbidity Only</td>
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<tr>
<td>Total Internalising</td>
</tr>
<tr>
<td>Externalising</td>
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<tr>
<td>CBCL Year 5 Morbidity Only</td>
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<tr>
<td>Total Internalising</td>
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<tr>
<td>Externalising</td>
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<tr>
<td>CBCL Year 2 &amp; 5 Morbidity Combined Total</td>
</tr>
<tr>
<td>Internalising</td>
</tr>
<tr>
<td>Externalising</td>
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<tr>
<td>Maternal Ethnicity* other</td>
</tr>
<tr>
<td>Gender of Child* male</td>
</tr>
<tr>
<td>female</td>
</tr>
<tr>
<td>Smoking in Pregnancy* none</td>
</tr>
<tr>
<td>1–10 daily</td>
</tr>
<tr>
<td>11–20 daily</td>
</tr>
<tr>
<td>21 +daily</td>
</tr>
<tr>
<td>Low Family Income in Pregnancy* &lt;$24,000 per annum</td>
</tr>
<tr>
<td>Father Living with Family* no</td>
</tr>
<tr>
<td>Number of siblings* none</td>
</tr>
<tr>
<td>1</td>
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<tr>
<td>2</td>
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<tr>
<td>3+</td>
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</tbody>
</table>

Missing cases not included in analysis unless stated otherwise, valid percentages used.
*Measured at 18 weeks gestation.
*Measured at 18 and 34 weeks gestation.
*Measured at age one, two and three years.
*Measured in hospital in days immediately following birth.
*Included in regression analyses as continuous variable.
Multinomial logistic regression analysis

Antenatal determinants. A younger maternal age (years) was significantly associated with an increase in child mental health morbidity in all outcome categories in the univariate analysis (Table 2). However, these results were not significant in the adjusted analysis (Table 3) except for externalising behaviour (Table 4) at age two (OR = 0.95, p < 0.05). Similarly, the univariate relationship between increasing years of maternal secondary education and fewer behavioural problems was no longer significant in the multivariable analysis for any of the behavioural outcomes. Mothers from non-Caucasian backgrounds showed a strong relationship with mental health morbidity at age two in the univariate regression analysis (OR = 2.54, p < 0.005), and this odds ratio increased in the adjusted analysis (OR = 3.34, p < 0.005), and was significant for internalising behaviours rather than externalising behaviours. Increasing numbers of cigarettes smoked per day during pregnancy was significantly predictive of mental health morbidity for all outcomes in the unadjusted results, and was significant at age two (OR = 1.30, p < 0.05) and age five years (OR = 1.19, p < 0.05) in the multivariable results for total behaviour, for both internalising and externalising behaviour at age two years, and externalising behaviour only at age five years. A family income below the poverty line during pregnancy was strongly linked with the development of child mental health problems in the univariate analysis; however, it was significant for total behavioural morbidity only at both ages in the multivariable results (OR = 2.68,
### Table 4

<table>
<thead>
<tr>
<th>Variables</th>
<th>Internalising Morbidity Year 2</th>
<th>Internalising Morbidity Year 5</th>
<th>Externalising Morbidity Year 2</th>
<th>Externalising Morbidity Year 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal Age at Conception (years)</td>
<td>0.96 (0.90–1.02)</td>
<td>1.01 (0.97–1.04)</td>
<td>0.99 (0.93–1.06)</td>
<td>1.05 (0.92–1.18)</td>
</tr>
<tr>
<td>Maternal Ethnicity (other)</td>
<td>2.55* (1.06–6.14)</td>
<td>1.05 (0.97–1.18)</td>
<td>4.47** (1.97, 1.18)</td>
<td>1.78 (0.99–3.58)</td>
</tr>
<tr>
<td>Smoking in Pregnancy (number of cigarettes per day)</td>
<td>1.26 (1.06–1.55)</td>
<td>1.06 (1.01–1.12)</td>
<td>1.63 (1.42–1.86)</td>
<td>1.08 (1.04–1.12)</td>
</tr>
<tr>
<td>Fathers Living with Family (no)</td>
<td>0.90 (0.35–2.31)</td>
<td>1.83 (0.94–3.56)</td>
<td>0.53 (0.14–2.05)</td>
<td>1.11 (0.99–1.25)</td>
</tr>
<tr>
<td>Stress Events in Pregnancy (number of events)</td>
<td>1.08 (1.04–1.14)</td>
<td>0.98 (0.94–1.03)</td>
<td>1.29 (0.92–1.78)</td>
<td>1.00 (0.96–1.04)</td>
</tr>
</tbody>
</table>

Maternal Age at Conception: a low maternal age was associated with increased internalising and externalising morbidity at age five years (OR = 1.07, p < .05). Maternal Ethnicity: Maternal ethnicity had a significant impact on both internalising and externalising morbidity at age five years (OR = 4.47, p < .005), and at both ages (OR = 1.78, p < .05) in both the adjusted analysis (reported) and the unadjusted analysis. More maternal smoking was associated with internalising morbidity at age five years (OR = 4.47, p < .005), and externalising morbidity at both ages two and five years (OR = 1.78, p < .05).

**Perinatal determinants.** Within the perinatal period, a low gestational age in weeks at birth was a significant risk factor for total behavioural morbidity at both ages two and five years prior to (OR = 0.96, p < .005) and following inclusion in the multivariable model (OR = 0.96, p < .005). A low family income was predictive of internalising morbidity at two years (OR = 2.43, p < .05) and externalising morbidity at two years (OR = 2.09, p < .005) and at both ages combined (OR = 1.87, p < .05). The absence of the biological father in the family home showed some relationships with total behavioural morbidity in the univariate results, though was significant only for internalising morbidity at age five in the adjusted analysis. Increasing numbers of stressful events experienced during pregnancy was significantly predictive of mental health morbidity at age two (OR = 1.20, p < .05), age five (OR = 1.17, p < .005), and at both ages (OR = 1.29, p < .005) in both the adjusted analysis (reported) and the unadjusted analysis. More stress experience was associated with internalising morbidity at age five years (OR = 1.23, p < .005), and externalising morbidity at both ages two and five years (OR = 1.23, p < .005).

**Postnatal determinants.** A longer duration of breastfeeding (in months) was significantly related to fewer child mental health problems at age five (OR = 1.08, p < .05) and at both ages (OR = 0.96, p < .005) in the unadjusted results. When breastfeeding length was included in the multivariate analysis, it remained protective for child mental health problems at age five only (OR = 0.97, p < .05) and was not significant for internalising or externalising behaviour. An increasing number of ‘baby blues’ symptoms in the immediate postpartum was a risk factor for child mental health morbidity at age five (OR = 1.08, p < .05) and at both ages (OR = 1.15, p < .005) for both the adjusted (reported) and unadjusted analysis. More ‘baby blues’ symptoms

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were also predictive of increased internalising morbidity at age five (OR = 1.09, p < .005) and both ages (OR = 1.20, p < .005) and externalising morbidity at age five only (OR = 1.08, p < .05).

Discussion

Our study aimed to comprehensively examine the antenatal, perinatal and postnatal determinants of mental health morbidity in the pre-school years. In this analysis we have looked at multiple risk factors for mental health morbidity in one model to minimise the effects of confounding bias that have limited previous research. We have also used an empirically validated outcome measure to examine child mental health, and we have conducted our analyses within a large prospective pregnancy cohort to enhance the reliability of the findings and eliminate problems associated with retrospective recall.

In all three outcome categories the experience of multiple stress events in pregnancy was predictive of a clinically significant T-score for total behaviour after adjustment for multiple other risk factors, and the effects were equally balanced across internalising and externalising sub-scales. This finding supports the link between stress experience in pregnancy and fetal neuro-development that has been previously found (Rice et al., 2007; Wadhwa et al., 2001), but adds to the literature in revealing that the strength of this relationship persists even in the light of other major influences on child mental health morbidity. Clearly this factor is of great significance in establishing the epidemiology of behavioural morbidity in early childhood. One hypothesis suggests that this relationship is mediated by premature exposure to cortisol, which may prepare the fetus for a world the mother perceives as difficult and hence inattention and externalising behaviour may represent the child’s behavioural adaptation to a stressful world (Crowther et al., 2007; French, Hagan, Evans, Mullan, & Newnham, 2004). Reporting a greater incidence of stress may also reflect maternal mental health status. The Avon Longitudinal Study of Parents and Children (ALSPAC), a large-scale prospective cohort study, examined the influence of clinically significant maternal anxiety during pregnancy on child mental health outcomes at age four and found a significant relationship between high levels of prenatal anxiety and poorer mental health outcomes in the early years (O’Connor, Heron, Golding, Beveridge, & Glover, 2002).

Maternal smoking during pregnancy was a significant risk factor for later child behavioural problems at age two and at age five, in particular externalising behaviour which is consistent with the existing literature (Button, Maughan, & McGuffin, 2007; Maughan, Taylor, Caspi, & Moffitt, 2004). In terms of general health outcomes, prenatal smoking may be the single most preventable cause of child health problems (Logan & Spencer, 1996). Smoking behaviours are closely linked with sociodemographic status, including low income, and have been suspected as a proximal risk factor reflecting the larger influence of socioeconomic status on mental health outcomes (Logan & Spencer, 1996). However, we did not find significant interaction effects in our study for antenatal maternal smoking, indicating that smoking is not primarily influencing child mental health status in a proxy capacity. As recently noted by Button et al. (2007), it is clear that a direct influence is present between smoking in pregnancy and psychological problems, but what remains unknown is the mechanism through which this influence operates.

Maternal ethnicity (non-Caucasian) was significantly associated with overall child mental health at age two in the adjusted analysis, in particular for internalising problems where significant odds ratios were evident at age two and at both ages two and five. This may reflect the barriers faced by women from minority ethnic groups in accessing support for preschool children. Mothers from culturally and linguistically diverse backgrounds also face barriers other than socioeconomic resources, such as language, lack of social capital and discrimination, and these factors in turn may affect child mental well-being in the early years (Wen, 2007). The majority of the sample of ‘other’ ethnicity was comprised by Asian mothers and previous research has found that Asian populations are usually less likely to experience the same disparities related to child outcomes as other ethnic groups, though our finding would suggest that some difficulties or disparities do indeed exist (Wen, 2007).

For the remaining antenatal risk factors, we found a number of significant results. Early childhood has been identified as the developmental stage where family income has the greatest effect on child development (Duncan & Brooks-Gunn, 2000). Our study showed that economic hardship in pregnancy was a strong predictor of total mental health morbidity at both ages two and five, and also had a significant effect on internalising behaviour at age two and externalising behaviour at age two and at both ages. A younger maternal age was a significant predictor of externalising morbidity at age two and at both ages two and five; however, maternal age was not significant in the multivariable model. The correlations between maternal age and other variables are likely to explain this result, with maternal age significantly correlated with all other variables except the gender of the child.

We saw a protective effect of increasing years of high school education experienced by the mother; however, this disappeared probably due to co-action of other predictors such as stress, smoking and low income. Specifically, the absence of the biological father in the family home in pregnancy was predictive of internalising morbidity at age five in the
adjusted analysis, though not significant in the adjusted models for overall behaviour. It is suggested that being a single parent is associated with poorer child mental health outcomes and that the younger a child is when their parents separate, the worse the mental health outcome – with children whose parents have been separated since birth or before to be at the greatest risk (Clarke-Stewart, Vandell, McCartney, Owen, & Booth, 2000). However, numerous factors, such as antisocial behaviour of the father, mediate this relationship (see Jaffee, Moffitt, Caspi, & Taylor, 2003) and may be responsible for the opposing directions of effect seen in the multivariable model.

Three perinatal risk factors were explored within this study. A lower gestational age in weeks at birth was predictive of the continuity of mental health morbidity in early childhood, particularly externalising morbidity, at ages two and five and is congruent with retrospective findings that children born pre-term are more likely to experience early mental health morbidity (Zubrick et al., 2000). Our results show that babies of a younger gestational age at birth may face significant mental health challenges throughout the pre-school years in addition to known physical health challenges (Aday, 1994). In our study, male children showed more behavioural morbidity than female children, with significant results for overall behaviour and internalising behaviour at age five, and significantly more externalising behaviour at age two. Other studies have found male children to be more at risk of externalising behaviour than female children (Baillargeon et al., 2007; O’Callaghan et al., 1997), and it is thought that externalising behaviour in boys is more salient to mothers than in girls (Najman et al., 2001).

Having more siblings was related to better overall mental health status in our study at both ages two and five, and was significantly predictive of less internalising morbidity at age five only. The important role that siblings play in a child’s social environment has been noted previously (Leventhal & Brooks-Gunn, 2000), and having siblings at the time of birth has been associated with externalising behaviour such as physical aggression (Tremblay et al., 2004). The results from this study show that having more siblings is protective for mental health status, although more so for internalising behaviour than for externalising behaviour.

Finally, we examined two risk factors from the postnatal period. Breastfeeding for a longer period showed a significant protective effect initially in the univariate analysis which remained for total behaviour T-scores above the clinical cut-point at age five only but otherwise was overshadowed by other sociodemographic risk factors.

The link between maternal depressive symptoms immediately postpartum and later child psychopathology has long been recognised (Phillips & O’Hara, 1991). We found the presence of multiple ‘baby blues’ symptoms in the immediate postnatal period to be highly predictive of persistent mental health morbidity in the pre-school years, and strongest with later internalising morbidity but still influential with externalising behaviour at both ages. This suggests that withdrawal and anxious/depressed symptomatology are the specific behavioural consequences of maternal postpartum blues. Given the positive association between multiple ‘baby blues’ symptoms and clinical postpartum depression (Henshaw et al., 2004), our findings suggest that early intervention with mothers experiencing multiple ‘baby blues’ symptoms may be a strategy to prevent the later development of mental health problems in offspring.

Strengths and limitations

The main strength of our study was the use of a large pregnancy cohort followed to age five years that provided information relating to a wide range of biomedical, sociodemographic and psychosocial factors collected from 18 weeks gestation and prospectively throughout early childhood, thus allowing for multiple risk factor analysis at several critical developmental stages. The large sample size enabled rigorous analysis and generalisability for other populations of mothers and children showing similar characteristics. Research on the risk factors associated with poor child mental health outcomes to date has predominantly been cross-sectional in nature, or based on retrospective recall of data, both potentially unreliable strategies that can dilute the potency of findings (Allen et al., 1998; Kraemer et al., 1997).

Our use of the CBCL, a well-established measure of mental health morbidity, is a particular strength of the study, as the CBCL has shown good internal consistency in the diagnosis of child psychopathology in many previous reports (Bird, Gould, Rubio-Stipec, & Staghezza, 1991). The CBCL was shown to be comparable to the DISC diagnostic schedule (based on DSM-III), suggesting that the CBCL is as good at identifying children with psychiatric morbidity as a time-consuming diagnostic interview (Jensen et al., 1996). Similar results have been found with Western Australian children (Zubrick et al., 1995). Thus the use of the CBCL allows our findings to be compared with those of other studies describing trajectories of childhood mental health problems and behavioural psychopathology.

The use of maternal self-report for the CBCL as our primary outcome measure has been validated (Warnick, Bracken, & Kasl, 2007), although child behaviour ratings may have been affected by the mother’s own experience of stress and depressive symptomatology postnatally (Najman et al., 2001). Our use of mothers’ ratings of ‘baby blues’ symptoms in the immediate postpartum period (within days) and measures of child behaviour at age two and age five make it problematic to presume any inverse
causal relationship between earlier maternal mood and later CBCL responses.

Conclusion

Our study addresses the major methodological problems experienced by previous research into the early determinants of mental health morbidity in early childhood. We have shown that particular risks present in the ante-, peri- and postnatal periods have a significant independent influence on preschool child mental health, particularly stress, smoking, low income in pregnancy and multiple ‘baby blues’ symptoms immediately after birth. Our study contributes to a more complete understanding of the extent to which early determinants account for the population prevalence and continuity of mental health morbidity, as well as their potential as targets for prevention.

Supporting information

Additional supporting information may be found in the online version of this article:

Table 1 Univariate multinomial logistic regression analysis of stress events at 18 and 34 weeks gestation and total morbidity

Table 2 Univariate multinomial logistic regression analysis of stress events at 18 and 34 weeks gestation and internalising and externalising morbidity

Table 3 Correlations between explanatory variables using Pearson’s r

Table 4 Significant two-way interaction effects as a result of testing for interactions between explanatory variables in the multivariable model

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